What is claimed are:

1. A control apparatus of a variable valve timing mechanism that changes a rotation phase of a camshaft relative to a crankshaft of an internal combustion engine by an actuator, comprising:

a first sensor outputting a signal synchronized with the rotation of said crankshaft;

a second sensor outputting a signal synchronized with the rotation of said camshaft;

a phase detecting section that detects said rotation phase based on the signals from said first and second sensors;

a controlled variable detecting section that detects controlled variable of said actuator;

a conversion section that converts said controlled variable into the rotation phase with a transfer function representing said variable valve timing mechanism;

an estimation value calculating section that calculates an estimation value of rotation phase based on the rotation phase detected by said phase detecting section and the rotation phase obtained by said conversion section; and

a control section that outputs an operating signal to said actuator based on said estimation value and a desired value.

2. A control apparatus of a variable valve timing mechanism according to claim 1,

wherein said estimation value calculating section calculates a change amount per unit time of the rotation phase obtained by said conversion section, and calculates the estimation value of rotation phase based on the rotation phase detected by said phase detecting section and said change amount.

3. A control apparatus of a variable valve timing mechanism according to claim 2,

wherein said estimation value calculating section adds to a most newest value of the rotation phase detected by said phase detecting section, an integral value of said change amount calculated after said most newest value is calculated, to calculate the estimation value of rotation phase.

4. A control apparatus of a variable valve timing mechanism according to claim 3,

wherein said estimation value calculating section reads the detection result of the rotation phase in said phase detecting section at each fixed period of time, and judges whether or not the rotation phase is updated by said phase detecting section

based on a change in the rotation phase during said fixed period of time.

5. A control apparatus of a variable valve timing mechanism according to claim 1,

wherein said first sensor outputs a signal at each unit angle of said crankshaft and a signal at each reference angle of said crankshaft, and also

said second sensor outputs a signal at each reference angle of said camshaft, and

said phase detecting section counts up the signal at each unit angle of said crankshaft during a period of from the signal at each reference angle of said crankshaft to the signal at each reference angle of said camshaft, to detect the rotation phase based on the counted value.

6. A control apparatus of a variable valve timing mechanism according to claim 1,

wherein said actuator is an electromagnetic actuator, and

said controlled variable detecting section detects the current of said electromagnetic actuator.

7. A control apparatus of a variable valve timing mechanism according to claim 1,

wherein said actuator is an electromagnetic actuator, and

said controlled variable detecting section detects the voltage of said electromagnetic actuator.

8. A control apparatus of a variable valve timing mechanism according to claim 1,

wherein said variable valve timing mechanism changes the rotation phase of the camshaft relative to the crankshaft of the internal combustion engine by a braking force of an electromagnetic brake as said actuator.

9. A control apparatus of a variable valve timing mechanism according to claim 1,

wherein said variable valve timing mechanism is constituted so that;

a driving rotor that is transmitted with the rotation of the crankshaft of the internal combustion engine and a driven rotor on the camshaft side are coaxially connected with each other via an assembling angle adjusting mechanism, and an assembling angle between said driving rotor and said driven rotor is changed by said assembling angle adjusting mechanism, to vary valve timing, and

wherein said assembling angle adjusting mechanism includes a link arm with

a rotating portion on a first end portion thereof and a sliding portion on a second end portion thereof, a guide plate formed with a spiral guide groove, and an electromagnetic brake relatively rotating said guide plate with respect to said driving rotor,

the rotating portion of said link arm is rotatably connected with one of said driving rotor and said driven rotor, and the sliding portion of said link arm is slidably connected with a radial guide formed on the other of said driving rotor and said driven rotor,

the sliding portion of said link arm is fitted with the spiral guide groove of said guide plate, and

said guide plate is relatively rotated with respect to said driving rotor by said electromagnetic brake so that the sliding portion of said link arm is slid in radial along said radial guide, to change the assembling angle between said driving rotor and said driven rotor.

10. A control apparatus of a variable valve timing mechanism that changes a rotation phase of a camshaft relative to a crankshaft of an internal combustion engine by an actuator, comprising:

crank angle signal outputting means for outputting a crank angle signal synchronized with the rotation of said crankshaft;

cam angle signal outputting means for outputting a cam angle signal synchronized with the rotation of said camshaft;

phase detecting means for detecting said rotation phase based on said crank angle signal and said cam angle signal;

controlled variable detecting means for detecting controlled variable of said actuator;

conversion means for converting said controlled variable into the rotation phase with a transfer function representing said variable valve timing mechanism;

estimation value calculating means for calculating an estimation value of rotation phase based on the rotation phase detected by said phase detecting means and the rotation phase obtained by said conversion means; and

operating signal outputting means for outputting an operating signal to said actuator based on said estimation value and a desired value.

11. A control method of a variable valve timing mechanism that changes a rotation phase of a camshaft relative to a crankshaft of an internal combustion engine by an actuator, comprising the steps of:

outputting a crank angle signal synchronized with the rotation of said crankshaft;

outputting a cam angle signal synchronized with the rotation of said camshaft;

detecting said rotation phase based on said crank angle signal and said cam angle signal;

detecting controlled variable of said actuator;

converting said controlled variable into the rotation phase with a transfer function representing said variable valve timing mechanism;

calculating an estimation value of rotation phase based on the rotation phase detected based on said crank angle signal and said cam angle signal, and the rotation phase obtained by converting said controlled variable; and

outputting an operating signal to said actuator based on said estimation value and a desired value.

12. A control method of a variable valve timing mechanism according to claim 11, wherein said step of calculating an estimation value comprises the steps of:

calculating a change amount per unit time of the rotation phase obtained by converting said controlled variable; and

calculating the estimation value of rotation phase based on the rotation phase detected based on said crank angle signal and said cam angle signal, and said change amount.

13. A control method of a variable valve timing mechanism according to claim 11, wherein said step of calculating an estimation value comprises the steps of:

calculating a change amount per unit time of the rotation phase obtained by converting said controlled variable;

adding to a most newest value of the rotation phase detected based on said crank angle signal and said cam angle signal, an integral value of said change amount calculated after said most newest value is calculated; and

setting the adding result to the estimation value of rotation phase.

14. A control method of a variable valve timing mechanism according to claim 13, wherein said step of calculating an estimation value further comprises the steps of:

reading the detection result of the rotation phase in said step of detecting a rotation phase at each fixed period of time; and

judging whether or not the rotation phase is updated in said step of detecting a rotation phase based on a change in the rotation phase during said fixed period of time.

15. A control method of a variable valve timing mechanism according to claim 11, wherein said step of outputting a crank angle signal outputs a signal at each unit angle of said crankshaft and a signal at each reference angle of said crankshaft,

and also

said step of outputting a cam angle signal outputs a signal at each reference angle of said camshaft, and

said step of detecting a rotation phase comprises the steps of:

counting up the signal at each unit angle of said crankshaft during a period of from the signal at each reference angle of said crankshaft to the signal at each reference angle of said camshaft; and

detecting the rotation phase based on the counted value.

16. A control method of a variable valve timing mechanism according to claim 11, wherein said actuator is an electromagnetic actuator, and

said step of detecting controlled variable detects the current of said electromagnetic actuator.

17. A control method of a variable valve timing mechanism according to claim 11, wherein said actuator is an electromagnetic actuator, and

said step of detecting controlled variable detects the voltage of said electromagnetic actuator.